

WINCHITE AND CROCIDOLITE ASBESTOS IN A HISTORICAL SAMPLE OF THE LIBBY, MONTANA VERMICULITE PRODUCT

by Mark Germine, M.D., M.S., and John Puffer Ph.D., Geology Department,
Rutgers University, Newark, NJ:

A historical sample of the crushed and expanded vermiculite product from the former W.R. Grace and Company mine in Libby, Montana was obtained and analyzed. The product was mined from a weathered biotite pyroxenite consisting mostly of clinopyroxene, vermiculite, and biotite. Examination with a 10X hand lens revealed no asbestiform amphiboles. Under polarized light microscopy at magnifications of 100X to 1500X, dust from the sample was found to contain about 18% fibrous amphibole. The amphibole had a distinct blue or blue-green to yellow or yellow-brown pleochroism, with some deeper blue lamellae consistent with magnesioriebeckite. All optical data were consistent with identification as of the amphiboles as winchite with trace crocidolite. Fiber and fiber aggregates were in various stages of progressive near-surface weathering alteration. Fresh fibers were coarse and blocky, with sharp, inclined extinction. Alteration caused oxidation and splitting along cleavage planes, producing shredded and oxidized aggregates of shard-like fibers and thin fibers of high aspect ratio, along with an amorphous oxidation product. Quantitative TEM analyses of fibers of the suspended dust were performed using electron diffraction and X-ray spectroscopy on randomly selected amphibole fibers. Spectroscopic chemical analyses used established mineral standards and were fully corrected for variables that could cause errors in the analyses. Four shard-like fibers, with a mean aspect ratio of 7:1, were found to be winchite. Two long (greater than 15 microns), high aspect-ratio fibers were of indistinguishable winchite composition, while one was of magnesioriebeckite or crocidolite composition. Semi-quantitative data on numerous other fibers showed all to be consistent with quantitative data. Previously, two gross asbestos samples from Libby have been reported (1) to be winchite, but we know of no previous reports of winchite or crocidolite in the product. Others have reported gross samples and microscopic fibers to be of tremolite, actinolite, and/or richterite composition. None of these other minerals were found by TEM. Winchite is currently unregulated under OSHA and EPA. Amphibole fibers formed by splitting rather than crystal faces are also unregulated under OSHA and under dispute in current EPA practice. The importance of fiber surface oxidation is not considered, despite the clear role of oxidation products in carcinogenesis. Further quantitative mineralogical analyses are urgently needed, including analyses of fibers recovered from tissues of exposed individuals.

1. Wylie, A., and Vertrouteren, J. (2000) *American Mineralogist* 85, 1540-1542.

Authors:

Mark Germine, M.D., M.S.

John Puffer, Ph.D.

